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RESEARCH

Occupational health and safety hazards associated with informal solid waste scavenging at Richmond Sanitary Landfill, Bulawayo, Zimbabwe

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Abstract
Solid waste scavenging has historically been a challenge in most developing countries. This study assesses occupational health and safety (OHS) hazards associated with informal solid waste scavenging at Richmond Sanitary Landfill (RSL) in Bulawayo city, Zimbabwe. The case study research design was used combining qualitative and quantitative methods. Data was collected from secondary sources as well as primary sources using questionnaires, interviews, and observations. The participants were sampled using snowball and purposive sampling methods. A total of 90 questionnaires were administered to representatives of selected households involved in scavenging at RSL from which inferences were made. The data was analysed using the Statistical Package for Social Sciences (SPSS). Occupational health and safety hazards at RSL were dominated by ergonomics hazards emanating from manual lifting and awkward postures (86%), dust (79%), leachate ponds (50%), noise (58%), sharp objects (43%), chemical contaminated waste (21%) and pathogen infested waste (17%) all of which have potential to cause injuries and illnesses. OHS hazards were identified as a risk factor and a Chi square test of the association between occupational hazards and injuries encountered ($p=0.00$) was done. The Municipality of Bulawayo did not have a documented number of scavengers working at their landfill, or an OSH program. To address OHS issues, there is need for the Municipality to adopt an OSH policy. Training of scavengers and waste pickers is recommended to make them competent in identifying health and safety hazards, effective use of personal protective clothing and enabling them to uphold best safety and health practices.

Keywords OHS hazards · Solid waste · Scavenging · Injuries

Introduction

Scavenging is defined as the collection or selection of anything usable from garbage (Medina 2010; Shabani and Jerie 2023). International Labour Organization defines scavenging as a physical selection of reusable or recyclable matter from waste discarded at landfills, dump-sites or places where waste is collected. Scavenging is normally done in a bid to find reusable material or recyclable material from waste and turn it into valuable products (Chireshe et al. 2023). A scavenger is an individual who recovers reusable or recyclable materials that has been discarded and rendered useless by others, in order to sell or retain for personal use (Shabani and Jerie 2023; Ahmady 2024). Notably there is a growing number of scavengers worldwide, especially in developing countries yet the practice worryingly has multiple inherent hazards involved (Zhavairo and Jerie 2025).

In most developing countries, scavenging is illegal contrary to developed countries where scavenging activities are encouraged as a way to reduce greenhouse gases in the atmosphere and help in managing waste (Medina, 2007; Chireshe et al. 2023). Scavenging poses high risk of injury or illness to individuals engaged in the activity (Malik et al. 2020; Michael et al. 2024; Shankar and Swaroop 2021). Adhikari (2003) observed that in Egypt, waste picker communities had a high infant mortality rate with the death of 1 infant under the age of one year out of every 3 live births. These deaths were fuelled by their vulnerability to diseases based on their occupation as scavengers. Diseases

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such as respiratory disorders, typhoid, eye problems and skin diseases affect scavengers and their communities since waste pickers transfer waste pathogens to their communities (WHO 2016; Chireshe et al. 2023; Inyang and Ekong 2024; Omokaro 2024). Therefore, this study provides essential information that contributes towards the attainment of Sustainable Development Goal (SDG) 3 that targets good health and well-being of people as it exposes the safety and health problems associated with scavenging (Chireshe et al. 2023).

In Zimbabwe, particularly in Bulawayo and Harare cities, scavengers have constantly been increasing in numbers (Teta 2017; Chireshe et al. 2023). This increase is due to the harsh economic situation prevailing in the country leading to high rates of poverty and food insecurity. Scavengers usually collect reusable and recyclable material for example plastic bottles, cardboard boxes, cans, wires and metals (Jerie 2005; Sheinberg 2012). Zimbabwe has high rates of unemployment due to an unstable economy which has been worsened by the unstable political system in the country (Zhavairo and Jerie 2025). This has increased scavenging in most parts of the country especially at dump-sites and landfills. One of the largest landfills in Zimbabwe that is facing this challenge is the Richmond Sanitary Landfill (RSL) in Bulawayo, normally called Ngozi Mine by scavengers around the landfill. Richmond Sanitary Landfill, is owned by the Bulawayo City Council since 1994. The surrounding communities practice scavenging in the landfill and sift through solid waste searching for valuable material to resell to wholesalers.

The Environmental Management Agency in Bulawayo indicated that non-toxic biological waste is supposed to be disposed of in Richmond Sanitary Landfill, implying toxic waste must be treated first before disposal. However, this has not always been the case as this is not being adhered to in a number of cases. The Bulawayo City Council established a weighbridge at Richmond Sanitary Landfill site which is the first of its kind in Zimbabwe to help the council measure waste being disposed. The bridge helps the council measure waste coming from private entities and charge them a fee which increases revenue generation.

Waste in many developing countries is ideal for conversion into organic fertiliser while economic factors favour composting in countries where food production is high (Jerie et al., 2022). Refuse composting converts the fermentable organic content of refuse into a soil conditioner (Shabani and Jerie 2023). In the poorest countries, very simple screening and manuring can produce good results considering the economic realities which the inhabitants face. At one time Harare City Council operated a composting plant just less than one kilometre from the former Mabelreign drive-in-cinema (Teta 2017). This converted refuse free from material that is not biodegradable into organic manure. Operations at the plant slowed down largely due to costs since manure is bulky and expensive to transport.

There is dearth of information on how informal solid waste scavenging affects scavengers' health through injuries and illnesses. The specific objectives of this study are to;

1) Identify occupational health hazards associated with informal solid waste scavenging at Richmond Sanitary Landfill.
2) Analyse occupational safety hazards associated with informal solid waste scavenging at Richmond Sanitary Landfill.
3) Examine the types of solid waste collected by informal scavengers at Richmond Sanitary Landfill.
4) Examine occupational practices adopted by informal solid waste scavengers at Richmond Sanitary Landfill.
5) Assess work related injuries and illnesses associated with informal solid waste scavenging at Richmond Sanitary Landfill, Bulawayo, Zimbabwe.

Materials and methods

Location of study area

The study was conducted at Richmond Sanitary Landfill in Bulawayo, Zimbabwe (Fig. 1). The landfill is owned by the Bulawayo City Council. Richmond Sanitary Landfill is one of the largest dumping sites in Zimbabwe. It is located 12 km from Bulawayo's central business district and lies adjacent to Cowdray Park which is one of Bulawayo's most populated suburbs (Teta 2017). All the household, industrial and commercial solid waste collected from the city is deposited at the landfill. Bulawayo city has a population of 665,952 people and it produces waste that is disposed at the landfill (Zimeye 2018; ZIMSTAT, 2022; United Nations Department of Economic and Social Affairs Population Division, 2023).

The landfill is surrounded by residential suburbs such as Luveve and Cowdray Park which are fast growing and low-income communities (Zimeye 2018). Some people in these communities rely solely on the landfill as a source of income through collecting valuable and reusable waste to sell to wholesalers. Most of these scavengers survive on a 'hand to mouth' basis and the landfill is their only means of survival. Scavengers in these areas mostly comprise of people who are unemployed due to the prevailing harsh economic conditions. More than 300 makeshift homes (squatter dwellings) have been established around the landfill by scavengers who make a living from the landfill (Teta 2017). Apart from this community, there are

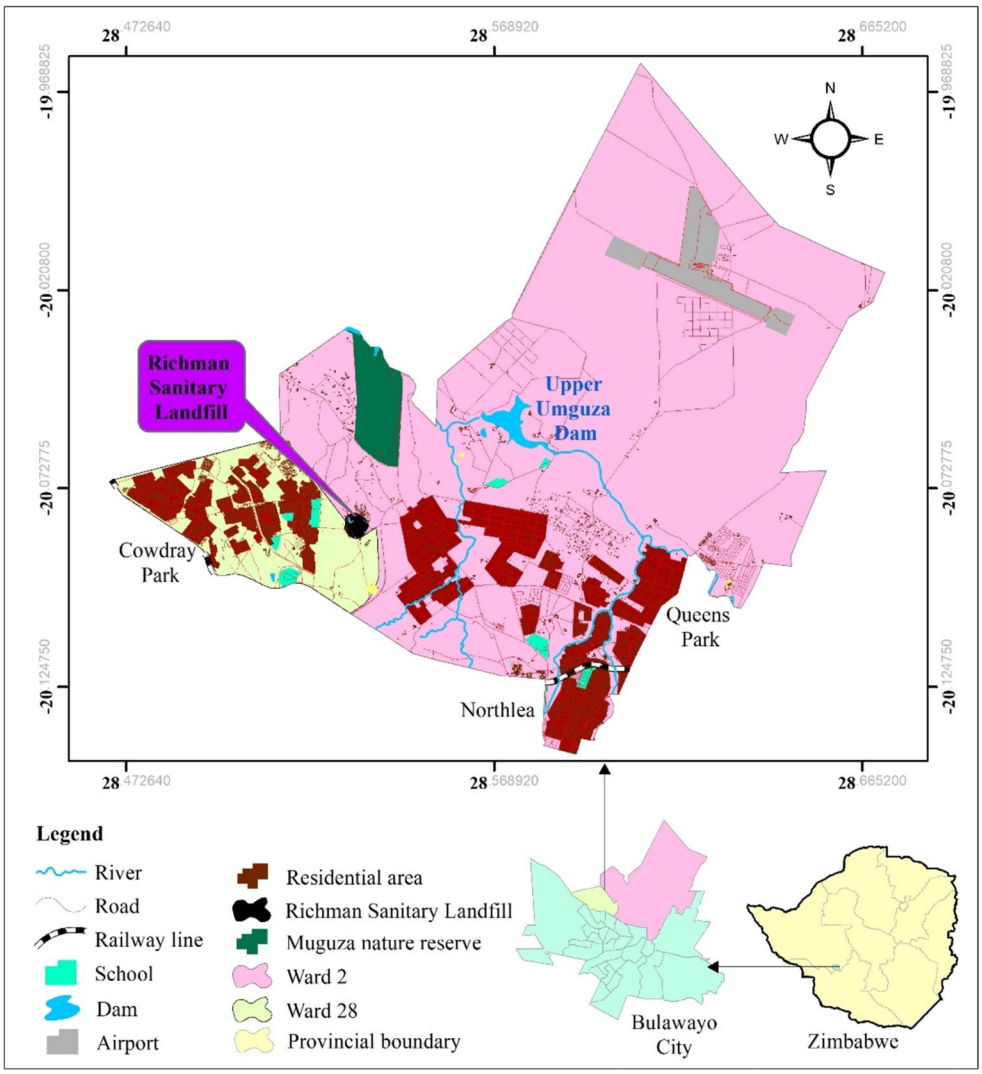

Fig. 1 Location of Richmond Sanitary Landfill in Bulawayo, Zimbabwe. Source: MSU GESRB Department (2024)

some formal and informal businesses that collect recyclable material in this landfill for example the National Waste Collectors, Skies and Better Tomorrow. There are also scavengers who come from nearby residential areas such as Luveve, Cowdray Park, Norwood and Emakhandeni suburbs. The combined total number of households in Luveve and Cowdray park residential areas is approximately 6375 households. The area borders Nyamandlovu in the west, Norwood suburb in the north, Richmond Sanitary Landfill to the east and Luveve Emakhandeni to the south (Teta 2017). The area's wet season is partially cloudy, with a dry season that is windy, clear and is warm through the year. Over the course of the year, the temperature typically varies from 8 °C to 29 °C and is rarely below 6 °C or above 34 °C. In the hot season Bulawayo (Richmond Sanitary Landfill) experiences very high temperatures due to uncontrolled burning on site and methane gas that acts as a greenhouse gas trapping heat in the atmosphere (Weather spark, 2021).

Data collection and analysis

The case study research design was adopted in this study as it provided an opportunity for a hybrid approach which involved collection of in-depth data about the entity through the use of a number of collection methods. Field data were obtained using combined qualitative and quantitative approaches between 29 June 2021 to 4 July 2021. The qualitative method usually relies on information obtained from interviews, focus groups, questionnaire documents and observations (Tobi, Hilde, Kampen and Jalr, 2018). The target population for this particular study included a known total of 6375 households in Cowdray Park; an estimated number of unauthorised residents (300) surrounding the landfill as well as an unknown figure of other scavengers that come to the landfill. It should be noted that, not all people from the 6375 households in Cowdray Park are involved in scavenging at the landfill. Only a few people make a living out of the practice. The people who are involved in

scavenging mostly comprise of the unemployed people. The number of unauthorised residents around the landfill is equally unknown and their population is not recorded by local authorities since they inhabit the area illegally. The number of makeshift homes has been estimated at 300 for this research based on a preliminary visit to the site (Teta 2017). The researchers targeted National Waste Collection (NWC) as well as Skies and Better Tomorrow, because the companies collect waste at the landfill. They also targeted the landfill supervisor at Bulawayo City Council because the individual oversees the day to day activities at the landfill. The Environmental Management Agency (EMA) were key informants as well because they regulate the landfill in their capacity as the sole national environmental regulation authority in Zimbabwe. Community members provided information relevant to identifying the different methods used by waste collectors in obtaining the valuable and recyclable waste. The NWC provided information on the injuries and illnesses associated with their occupation.

In this research, purposive sampling was adopted to select key informants. Purposive sampling was adopted since it enabled the selection of informants who were aware of the issues that were under investigation. This means that informants such as the representatives from National Waste Collection, Skies, Better Tomorrow, EMA together with the Landfill Supervisor from Bulawayo City Council were purposefully selected for the interviews. The researcher targeted Cowdray park households which were approximately 6375 and additionally 300 makeshift homes around the landfill. The researcher used snowball sampling combined with convenience sampling method to obtain the sample of households. Snowball sampling method is a non-probability sampling method where existing or present study subjects recruit future subjects from among their acquaintances (Goodman 1961). As the sample builds up, enough data is gathered which is relevant and useful for the study. These two methods were preferred because the scavengers that sift through the waste at the landfill are resident offsite, are of different ages and they also arrive at the landfill at different time periods to carry out their work hence it was difficult to find all of the scavengers at once at the landfill. The researchers also used snowball sampling because not all individuals at Cowdray Park are involved in scavenging but just a few people hence there was need for other scavengers to help lead the researchers to them and also obtain the times they arrive at the landfill so as to engage them.

A total of 90 questionnaires were administered to representatives of households involved in scavenging in the landfill (Table 1). This was done in a bid to reduce costs and increase efficiency by working with a selected few that represent a large population. Questionnaires provided were very useful and mostly relevant since they provided both quantitative and qualitative data. The questionnaire was made up of five sections. The first section obtained information on the socio-demographic characteristics of the respondents. Section B had questions addressing objective number (1) It had questions such as What types of household/industrial/construction/plastic waste do you pick? The other segment also obtained information aimed at addressing objective number (2) It included questions such as Are there any health hazards you are exposed to at the landfill during scavenging? Which ones are you exposed to? Section D had questions addressing objective number 3 such as what occupational health and safety practises do you adopt during waste picking at the landfill? Section E had questions addressing objective number 4 such as specify how frequent the following illnesses or injuries occur. The researchers self-administered the questionnaires as this increases the reliability and validity of the information collected. The questionnaires were written in English language and translated to local language of the respondents particularly Ndebele and Shona whenever necessary. The researchers used both open and closed ended questions. However, a few questionnaires were filled in by the researchers when they encountered illiterate respondents, hence the researchers asked the respondents questions and helped to fill the questionnaire. The tool provided data to test the hypothesis of the research. The H0 hypothesis was there is no association between occupational hazards and injuries among scavengers at RSL.

The researchers conducted interviews among selected scavengers asking about different practices that they engage in as they scavenge waste, the health hazards they are exposed to and the illnesses they face due to their practices. Appointments with key informants were made in order to allow full participation of the respondents when they were free. Information received was recorded using a recording

Table 1 Sample size and selection in relation to population

Selection	Target population	Sample size	Percentage of sample	Sampling method
Scavengers from Cowdray Park	6375	90	1.41%	Snowball sampling
Unauthorised scavengers living around the landfill	300	30	10%	Snowball sampling
Richmond Sanitary Landfill Supervisor at City Council	1	1	100%	Purposive sampling
National Waste Collection	1	1	100%	Purposive sampling
Better Tomorrow	1	1	100%	Purposive sampling
EMA officer	3	1	33.33%	Purposive sampling

Field data

device (phone), and some of it was captured in a notebook. The interviews were essential as they provided a platform to seek clarity on study issues thus obtaining detailed and relevant information. To corroborate collected data, a field observation checklist was explored to observe important phenomenon taking place at the site. This helped observe the type of waste that scavengers normally pick, the processes that they are involved in during foraging their way through the waste plus the health and safety hazards they are exposed to. This helped the researchers to get first-hand information that eliminated sole dependence on secondary data. The researchers used secondary data in the form of newspapers, research articles, media and government records to get relevant information concerning the study area. This included type of waste at Richmond Sanitary Landfill, valuable waste that scavengers sell and the various health and safety hazards associated with the foraging practices done by the scavengers. Qualitative data analysis was used by the researcher in the form of questionnaires, interviews, observations and secondary data. The data obtained from questionnaires was entered in Microsoft excel making sure the variables were in correct format and this was used to come up with percentages of responses from data collection.

Data was analysed using the inductive analysis method where the important themes were apparent through coding process. Collected qualitative data was used to assess the attitude and knowledge of scavengers concerning health and safety hazards. The data was subjected to qualitative content analysis and presented in graphs, charts, tables and pie charts. Age, employment status, gender and household size of respondents were some of the variables that were collected. Content analysis was used to summarise, classify and tabulate qualitative data. The Chi square test was used to determine whether or not there was an association between health and safety hazards present at the landfill and injuries and illnesses encountered by scavengers. The Chi-square test was a statistical procedure done by the researchers to test association between categorical variables within the same population (Kumar 2005).

Limitations of the study

The study adopted sampling strategies which had their key limitations. Snowball sampling, while useful for studying hidden populations, had limitations such as potential bias, difficulty in estimating sampling error, and challenges in generalizing findings. It was not a random process, and relied on referrals, which could have led to a sample that did not accurately represent the larger population. To add on the study adopted the purposive sampling which had several advantages. Purposive sampling, while useful, has limitations that include limited generalizability, potential for bias, and difficulty in replicating studies. The sample is not randomly selected, so findings may not apply to the broader population, and the researchers' judgment could have introduced bias. Additionally, replicating the study can be challenging due to the subjective nature of participant selection. Convenience sampling, while easy and efficient, has limitations. A primary issue is that the sample may not accurately reflect the broader population due to the non-random selection process, leading to potential bias. This can result in findings that cannot be generalized to the entire population and may not be representative.

Results and discussion

Socio-demographic characteristics of respondents

Male scavengers constituted 57.14% while female scavengers constituted 42.85% of all respondents in the study (Table 2). This is due to the nature of work done by scavengers at the landfill which involves a lot of strenuous work that is not always favourable to women plus most women stay at home to take care of the children. In a study done by Ngole (2017), on health effects affecting scavengers at Inyathi District Hospital in Zimbabwe, females were more than males, with 14 males and 16 females, which is contrary to this research. This is because the work done by scavengers in the scholar's study was not strenuous compared to the work done at Richmond Sanitary Landfill because the medical waste was picked at the hospital and it was not mixed together with organic and inorganic waste hence the sifting process was easier compared to the landfill in question where waste is mixed.

Scavengers below the age of 18 years accounted for 10% of the respondents while those above 18 up to 19 were 12.86%, those between 20–29 years were 15.71%, 30–39 years were 35.71%, 40–49 years were 21.43% and above the age of 50 years were 4.29% (Table 3). The use of child labour within the landfill as scavengers was observed in the study by the researchers when they encountered respondents that were below the age of 18 (10% of respondents). Scavengers above the age of 50 years had the least number of respondents (4.29%) due to the nature of the work that is heavily strenuous and favour young and energetic people that have more endurance. This was observed through the majority of

Table 2 Scavengers' distribution according to gender

Characteristics	Number	Percentage
Gender		
Male	40	57.14%
Female	30	42.85%

Field data

Table 3 Scavengers' age distribution

Age		
Characteristics	Number	Percentage
Below 18	7	10%
Above 18–19	9	12.86%
20–29	11	15.71%
30–39	25	35.71%
40–49	15	21.43%
50+	3	4.29%
Total	70	100%

Field data

the scavengers who were aged 18–39 years (64.28%) and 40–49 (21.43%), an observation which suggests that most of the scavengers at Richmond Sanitary Landfill are within the youthful and working age group respectively.

Waste pickers as young as 8 years old were found scavenging in China, helping their parents pick waste within dump-sites (Medina 2010). This concurs with the researcher's findings suggesting that child labour is exploited in scavenging. A research done by Chibiko at el., (1991) on health impacts of informal solid waste scavenging at Minna, Nigeria, concurs with the findings of this research as they reported that 51.39% of scavengers in their study were aged 18–38 years to also suggest that most scavengers are within the youth age range.

Type of solid waste at Richmond Sanitary Landfill

Soft plastics constituted 30% of the solid waste at the RSL. Soft plastics included such plastic material like plastic bags, biscuit wrappers, garbage bags, chip packets, cereal box liners, bread and pasta bags and salad packets (Fig. 2). Hard plastics constituted 18% of the solid waste. Hard plastics are plastics that are not easily biodegradable that included polypropylene, polyethylene terephthalate, polystyrene and polyvinyl chloride pipes. Metal constituted 2% of the solid waste. These were mainly aluminium cans, bicycles, bed frames and mattress springs. Electronic waste constituted 10% of the solid waste. These were mainly discarded televisions, computer monitors, printers, cables, lamps, scanners, phones and calculators. Medical waste covered 3% of the solid waste. These included COVID-19 personal protective clothing and equipment, needles, surgical masks and syringes. Paper accounted for 8% of the solid waste and it comprised of old newspapers, magazines and card boxes. Organic waste comprised 17% of the solid waste. Organic waste is any waste that is biodegradable which comes from either plants or animals. Organic waste included green waste, food waste and pruning waste. Other waste constituted 12% of the solid waste, these comprised of weaves, braids, clothes and shoes. This shows that soft plastics are the most abundant type of waste at Richmond Sanitary landfill, followed by hard plastics, organic waste, other waste, electronic waste, paper, medical and lastly metals in that order. The researchers interviewed an employee from Skies, a company that collects clear plastic bottles for recycling from the landfill which has huge amounts of plastic bottles disposed at the site. These plastics are recycled into plastic bottles, buckets, cups, plates and dishes. Therefore, the researchers confirmed the assertion that plastics are the bulk of the waste found at the landfill.

According to a research done by Teta (2017), there were similar results on the types of solid waste found at the landfill where soft plastics constituted 33% of the solid waste while hard plastics constituted 18.6%, paper 8%, organics 15.8%, electronic waste 0.8% and other waste 21.3%.

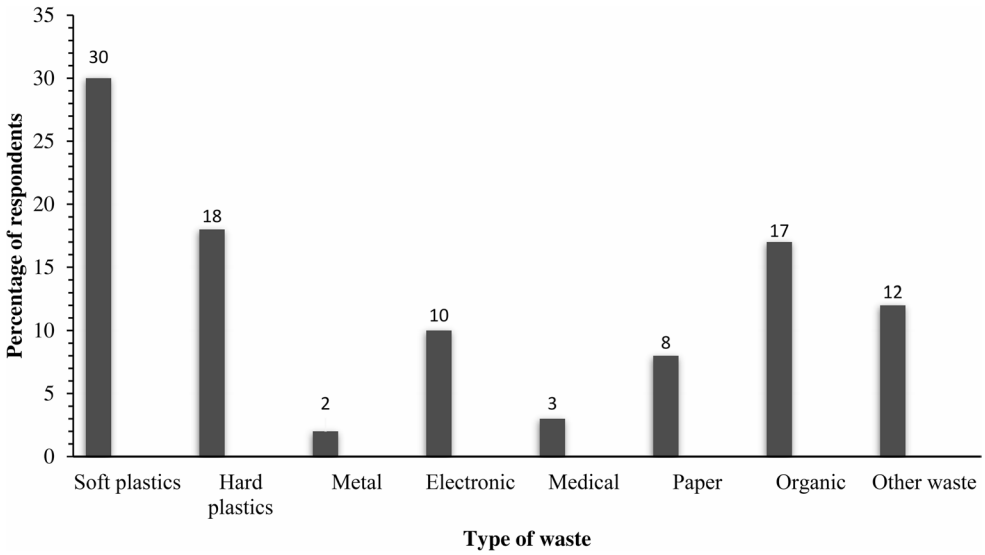

Fig. 2 Different types of waste at Richmond Sanitary Landfill. Source: Field data

Occupational health and safety hazards that informal solid waste scavengers are exposed to at Richmond Sanitary Landfill

All the respondents highlighted that they were exposed to at least one occupational hazard (Table 4). For example, 100% of all the scavengers were exposed to heat as a hazard. This heat is in the form of the sun that scavengers are exposed to throughout the day during waste picking as well as heat from occasional fires that occur at the landfill. A key informant told the researcher that the heat is sometimes unbearable especially in summer and since they work in the open and are highly exposed to it.

Responses from questionnaires suggested that 78.57% of all the scavengers at the landfill were exposed to high levels of dust and vehicle exhaust fumes. The researchers observed presence of dust at the landfill. A key informant said the dust carries foreign bodies into their eyes and cause difficulty in seeing. He went on to say that dust causes scavengers to cough and have difficulties in breathing.

Responses from scavengers revealed that they were exposed to chemical wastes. Respondents stated that they have come across empty containers of pesticides, agrochemicals and old batteries. Jerie (2016), says that lead bioaccumulate in the blood causing adverse long term health effects on internal organs. Moreover, contact with skin, ingestion or inhalation of these chemicals such as cleaning solvents, insecticides and herbicides causes central nervous system disorders. Scavengers at Richmond Sanitary Landfill are highly exposed to these chemicals due to their practice of picking waste directly with bare hands thus making direct skin contact with chemicals. The researchers observed that very few scavengers wore the full personal protective clothing (equipment), a few of the waste pickers only had gloves on while a lot more had no personal protective clothing at all. The researchers observed that these scavengers wore short sleeved clothing and gloves during their work, and some hand-picked waste without protective clothing which is a health hazard. 21.42% of the respondents acceded to being exposed to chemical waste. Table 4 shows that a total of 42.85% of the scavengers are exposed to sharp objects. Scavengers are exposed to sharp aluminium cans, screws and needles. A key informant said scavengers at the landfill are exposed to sharp aluminium cans during sorting out of waste. This is a major concern given evidence from this research that 35.71% of the scavengers lack protective clothing and equipment. The research revealed that 35.71% scavengers had no protective clothing during waste picking hence they are highly exposed to health and safety hazards. PPE helps to put a barrier between the worker and the hazard but 35.71% of scavengers at the landfill are fully exposed to health and safety hazards due to lack of PPE.

Table 4 Health and Safety hazards associated with informal solid waste scavenging

Health hazard	Number of respondents exposed	Percentage
Sharp objects	30	42.85%
Dust, smoke from burning waste, vehicle exhaust fumes	55	78.57%
Manual lifting, awkward postures	60	85.71%
Leachate	35	50%
Chemical contaminated waste e.g. pesticides	15	21.42%
Noise	40	57.14%
Pathogen infested waste e.g. medical waste and decomposing organic matter (food)	12	17.14%
Lack of personal protective clothing	25	35.71%
Heat	70	100%

Source: Field data

According to Panday (2004), scavengers in Palestine suffer from excessive exposure to heat that causes serious migraine headaches and affect their health. This suggests that scavengers suffer from exposure to heat which is harmful to their health as Teta (2017) established that scavengers suffer from respiratory disorders due to continuous exposure to dust and smoke from fires. This suggests that scavengers are exposed to dust during waste picking. Cointreau (2006), stated that ergonomic hazards are amplified by traditional solid waste management in developing countries such as manual lifting, pulling, heights and awkward postures during their work. According to Hanumantha (2008), some scavengers in South Africa, get injured by sharp objects resulting in illness or death ultimately. This suggests that scavengers are exposed to sharp objects during waste picking. This infringes their right to work in a safe environment that is free of injuries which frustrates efforts aimed at attaining Sustainable Development Goals; particularly Goal 3 that focuses on good health and wellbeing.

Occupational practices adopted by scavengers at Richmond Sanitary Landfill

Figure 3 shows that 14.29% of scavengers used bare hands when picking waste at the landfill. This is because these scavengers lack protective clothing to use during waste picking while 35.71% of them lack protective gear mostly because they cannot afford it. The researchers interviewed a waste picker who was formally employed by National Waste Collection to collect white and brown paper, he agreed to the fact that they pick waste using bare hand due to lack of protective clothing. This practice increases the chances of exposure to health and safety hazards, injuries and illnesses on scavengers. A key informant admitted to experiencing cuts by aluminium cans and scrap metal during hand

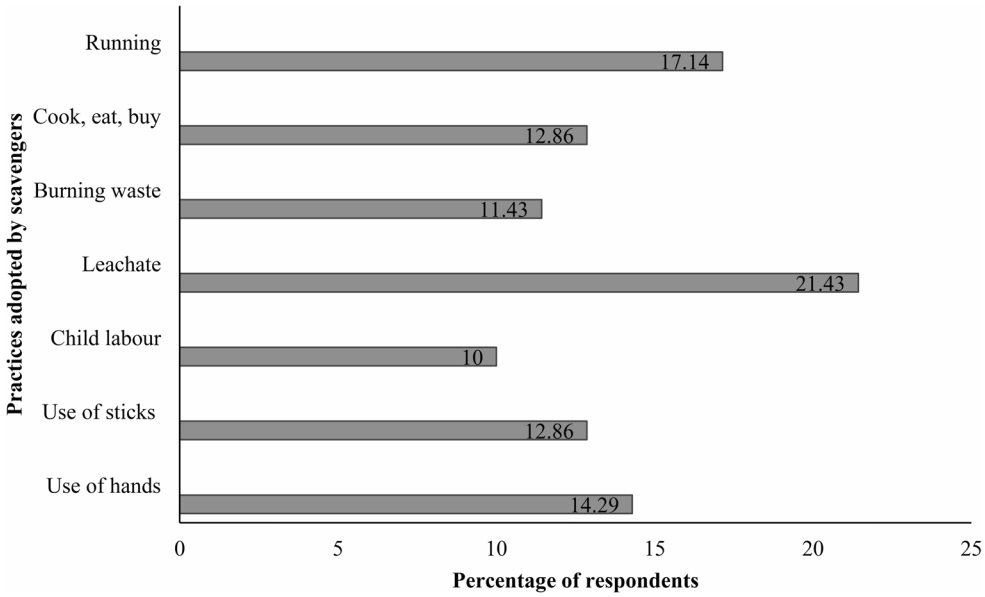

Fig. 3 Practices adopted by scavengers at RSL. Source: Field data

picking of waste at the landfill. These wounds expose them to pathogens, viruses and fungi further causing illnesses among scavengers. Scavengers in Indonesia were reported to flip items over their heads using bare hands into their baskets strapped on their backs and a few sorted through waste using their bare hands by Panday (2004).

Research findings of this study show that 17.14% of the scavengers literally chased after (running) moving trucks as they enter the landfill and board these moving trucks before they offload at the landfill. The trucks sometimes do not get the chance to offload the waste as the scavengers would have started picking their desired type of waste on-board. The researchers noted that this happens due to a lot of competition among scavengers who would be searching for a particular type of waste hence they try to acquire it before it is available to the rest of the scavengers. This behaviour among scavengers is very risky as they risk tripping and falling whilst chasing the trucks or even being run over by the moving truck resulting in serious injuries or sudden death respectively. Scavengers at the landfill clean the waste that they pick through washing it in leachate before selling to companies that buy such waste. The scavengers do not have nearby water sources to clean the waste hence they use the only available sources of water which are pools of leachate. According to the Bulawayo Municipality, scavengers disregard the danger of direct contact with leachate and wash their waste in it. The continuous contact with leachate is posing as a very serious health hazard to scavengers. Consumption of leachate causes sweating, bleeding, stomach disorders, blood disorders, congenital disabilities and even cancer and skin infections upon contact (Isaac et al. 1991).

Child labour is used in scavenging at the landfill. A total of 10% of the scavengers were children who were at the landfill scavenging. Children as young as eight years old were picking waste at the landfill some of whom were using their bare hands. These children are doing this to help their parents gather large quantities of waste at the landfill in a bid to earn a living. Most young people were observed running and boarding moving trucks to pick waste since they are the most energetic and vibrant ones when compared to the older people. Research findings from the International Labour Organisation, indicate that dumpsite scavenging is extremely hazardous for children as it exposes them not only to health risks but to long term emotional, intellectual and social damage. This was also common in the study area as it was presenting serious problems. Similarly, a study by Medina (2010) in China, indicated that children as young as eight years old are also observed scavenging in dump-sites alongside their parents collecting waste.

Work related injuries and illnesses associated with informal solid waste scavenging at Richmond Sanitary Landfill

Injuries encountered by scavengers at the landfill

Research findings of this study illustrated in Fig. 4 show that 50% of the scavengers at the landfill experience back pain. This tallies with the finding that 85.71% of the respondents were exposed on a daily basis to ergonomic hazards for long hours such as lifting heavy loads and working in awkward postures during sifting of waste. This was verified by observations made by the researchers, where these back and neck pains result from manual lifting and handling of large quantities of waste on a

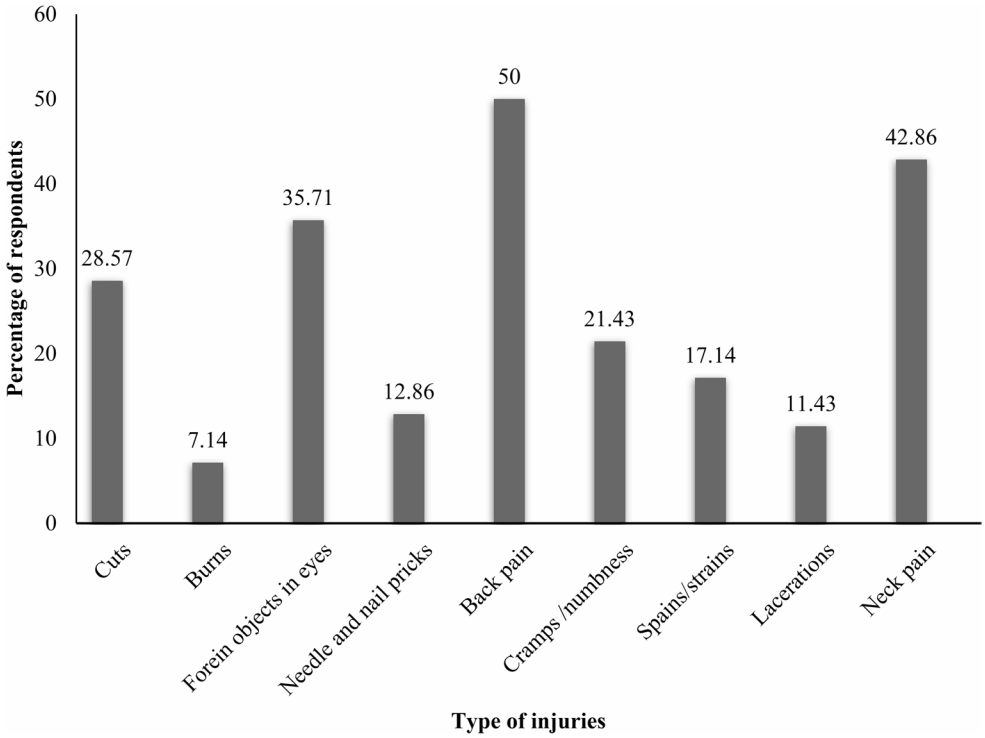

Fig. 4 Injuries encountered by scavengers. Source: Field data

daily basis (Fig. 4). Up to 42.86% of the scavengers admitted to experiencing painful necks. A total of 21.43% of the scavengers admitted to experiencing numbness of hands and feet, whilst 17.14% stated that they experienced either sprains, strains or broken limbs. A key informant said they experienced numbness of feet due to standing for long hours. 11.43% of the scavengers confirmed that they experienced lacerations. In a research done by Teta (2017), 40.7% of female scavengers and 38.6% of males experienced injuries during scavenging. This confirms that scavenging causes injuries among waste pickers.

Illnesses encountered by scavengers at the landfill

Up to 60% of all the scavengers at the landfill experienced headaches due to working under excessive heat since all of them were exposed to the heat hazard. Scavengers amounting to 35.71% got wounded on the hands and/or legs (Fig. 5). A total of 12.86% of the scavengers have once suffered from shortness of breath due to strenuous work and heat. The landfill has a strong stench emanating from decayed waste, smoke from burning waste and all of this causes up to 7.14% of the

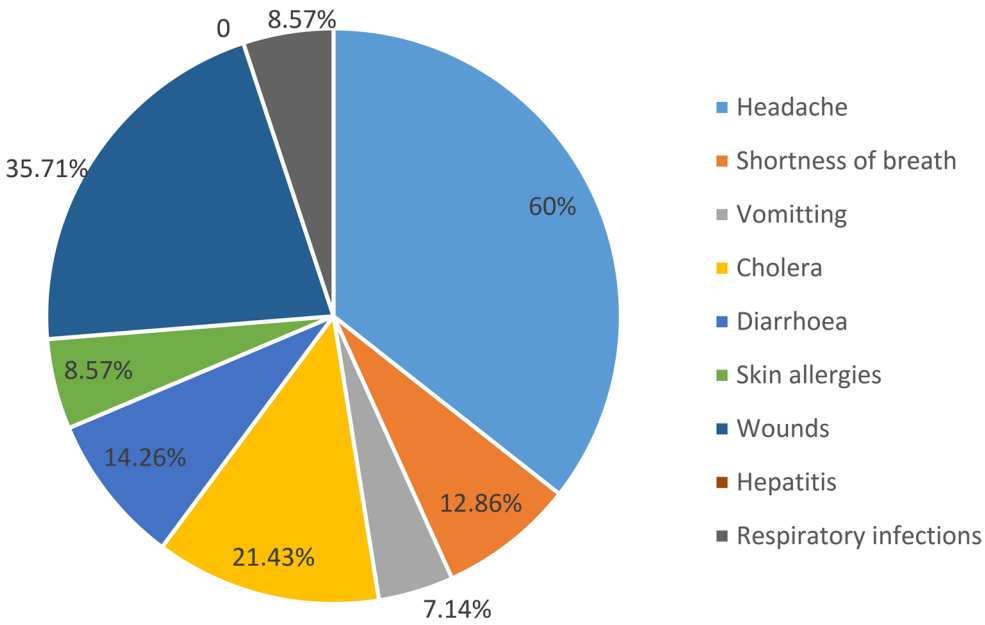

Fig. 5 Illnesses encountered by scavengers. Source: Field data

scavengers to vomit due to failure to withstand the smell. The manual handling of waste and subsequent eating of food without proper sanitation among waste pickers caused diarrhoea and cholera as confirmed by 21.43% of the respondents who admitted to once being ill from cholera and 14.26% from diarrhoea.

According to Medina (1997), in Manila more than 35 diseases were discovered among scavengers including diarrhoea, typhoid, cholera and dysentery. A study by Fanning and Fred (2003) also confirmed that some common health effects reported by scavengers in South Africa were, headache, shortness of breath and back pains which are problems also identified in the area under study.

Frequency of injuries among scavengers at the landfill

The findings of this study showed that 21.42% of waste pickers experienced cuts on a monthly basis due to handling sharp objects and 7.14% experienced cuts quarterly. This is because scavengers used bare hands to pick waste (Fig. 6). The findings also showed that the frequency of illnesses and injuries among scavengers is based on the frequency of the waste being picked, that is the use of personal protective clothing and practices used by scavengers in waste picking. About 35.71% scavengers experience accidental entry of foreign objects into their eyes weekly. This is due to the presence of dust caused by truck that bring waste at the landfill daily as well as wind. To add on to that, 12.86% of scavengers admitted to experiencing needle and nail pricks monthly. A key informant said even when they wear protective clothing they are sometimes pricked by sharp objects such as nails. The Bulawayo Municipality said scavengers normally wear torn protective clothing hence they are prone to experiencing nail and needle picks. A total of 31.42% of the scavengers suffer from back pain weekly, 27.14% experience neck pain weekly whilst 15.71% experience it monthly. This is due to manual lifting of big sacks of waste resulting in sprains, strains and broken limbs mostly due their practice of running after and boarding moving trucks. This causes them to trip and fall leading to broken limbs. A total of 7.14% scavengers suffer from broken limbs monthly and 10% quarterly. Results also show that about 4.29% of scavengers admitted to suffering from lacerations monthly, 2.86% quarterly and 4.29% annually. This is as a result of deep cups by aluminium cans. This tallies with findings of Jerie et al. (2022) and Michael et al. (2024) who observed that waste pickers in the informal sector often suffer from severe threats that are associated with the nature of work that is being conducted as they often wear torn protective clothing; conditions which presented similar problems in this study's context as well.

Frequency of illnesses experienced by scavengers at Richmond Sanitary Landfill

Scavengers indicated that up to 10% of them suffer from cholera on a monthly basis whilst 11.43% do so on an annual basis (Fig. 7). According to Bulawayo Municipality, scavengers suffer from cholera due to negligence in the area of hygiene. Owing to lack of clean water sources, scavengers often times eat food without washing hands and are also vulnerable to eating contaminated food when they consume food whilst at the landfill. Wounds on legs and hands occur among 7.14% of scavengers weekly while 15.71%

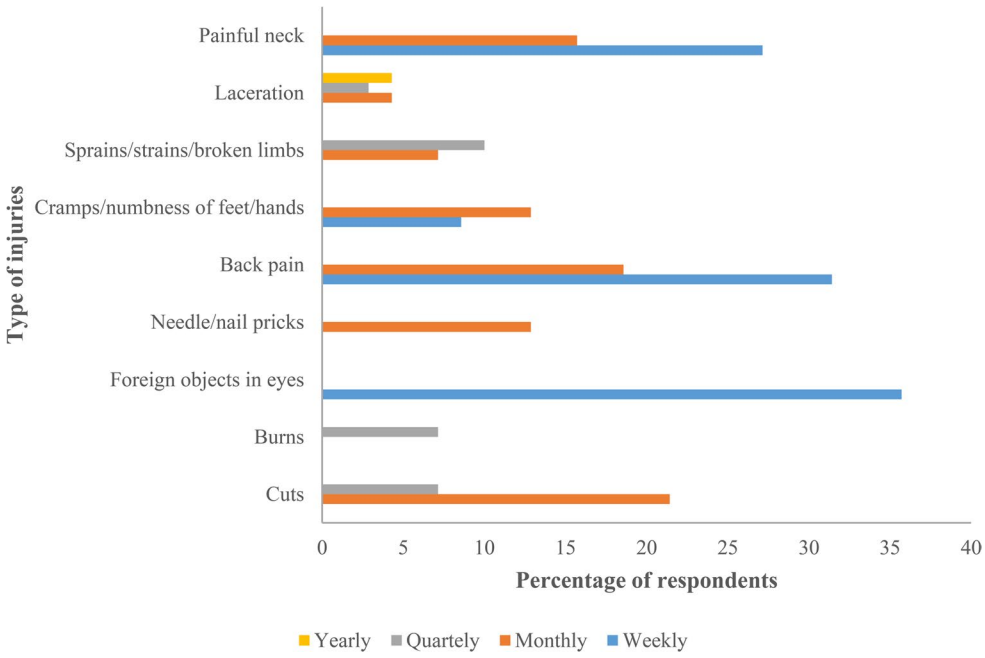

Fig. 6 Frequency of injuries among scavengers at Richmond Sanitary Landfill. Source: Field data

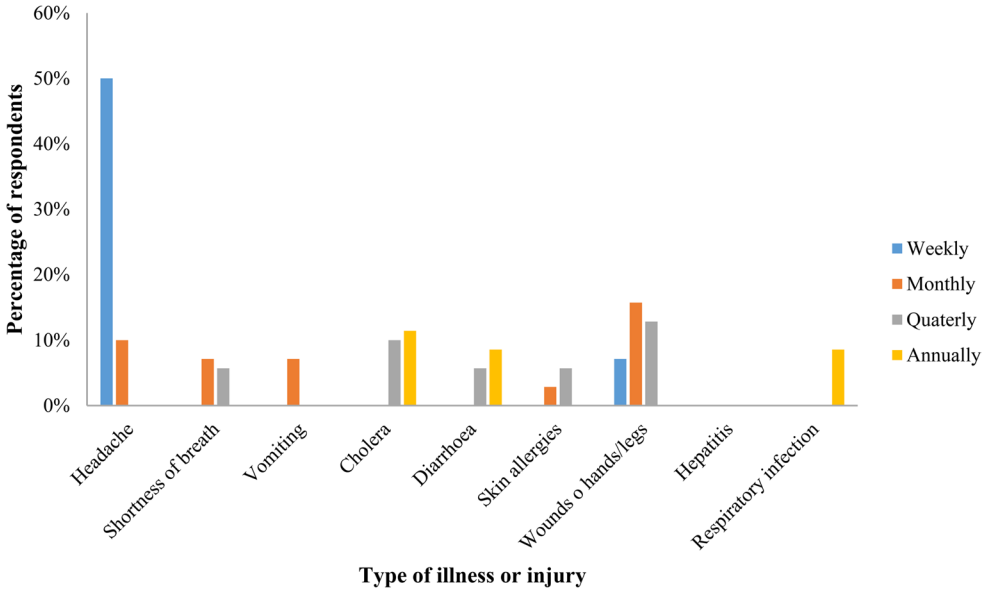

Fig. 7 Frequency of illnesses amongst scavengers at Richmond Sanitary Landfill. Source: Field data

experience them monthly and 12.86% yearly. The findings obtained indicated that 8.57% of waste pickers at RSL experience respiratory infections. Up to 2.86% of scavengers admitted to suffering from skin allergies monthly whilst 5.71% suffer from them quarterly. This is due to handling of chemical waste. 7.14% of the respondents admitted to vomiting monthly due to inhaling odours from decayed waste, 50% experience headaches weekly and 10% monthly. This is due to exposure to excessive heat from the sun. This finding tallies with that of Teta (2017) who observed that several employees involved in waste picking suffer from acute illness that range from wide range of activities. This if unchecked has potential to complicate efforts aimed at attaining Sustainable Development Goals in particular 3 on good health and well-being.

Chi-square test results ($P=0.00$) show that there is an association between occupational hazards and number of injuries encountered by informal solid waste scavengers. The X^2 calculated value was 29.58 and X^2 critical value at 16 degrees of freedom was 26.30. It is highly likely that, scavengers encounter injuries due to the different health and safety hazards they are exposed to at the landfill. In a study done by Shuvai (2017) on health and safety hazards associated with solid waste, there was a statistical relationship between hazards and injuries experienced by solid waste workers. Zolnikov et al. (2021) in their systematic review on informal waste picking focused on occupational hazards and health outcomes in developing countries. The results from this study showed that the most common occupational hazards were physical (77.6%), social (70.7%), biological (65.5%), chemical and safety (53.4%), ergonomic (34.5%) and mechanic (25.9%). Physical hazards as indicated by Zolnikov et al. (2021) were often associated with slips, trips, and falls, which makes sense because of the unstable environment where waste pickers work and this aligns to this research's findings. Black et al. (2019) studied the health risks of informal waste workers in the Kathmandu Valley and observed that non-use of PPE was independently associated with male gender (odds ratio [OR] 2.19; $P<0.001$), older age (OR 2.97 for more than the age of 55 years; $P=0.007$) and low perception of occupational risks (OR 2.41; $P<0.001$) as suggested by Nyathi et al. (2018). These statistical analyses validate this research's findings.

Conclusion and recommendations

The study assessed occupational health and safety hazards associated with informal solid waste scavenging at Richmond Sanitary Landfill, Bulawayo, Zimbabwe. The findings revealed that scavengers normally pick recyclable and reusable materials at the landfill which they sell to manufacturers for example scrap material, plastics, paper, card boxes and aluminium cans. These materials are then sold to manufacturers for resell or recycling. This research's findings also show that scavengers are poorly informed about the health and safety hazards they are exposed to hence the poor usage of personal protective clothing. This implies that the scavengers are at risk of compromised health as they have no alternative forms of protection since their work is not safety-focused but rather need driven which continues to present problems. Scavengers normally suffer from headaches, muscular skeletal disorders, respiratory infections, wounds on hands and legs due to their strenuous occupation. This exposes scavengers to severe risk which requires urgent attention as their right to good health and well-being is thus compromised. This calls for wider proactive thinking so as to address gaps in the existing scenarios so much

so that their condition could be improved. If this situation is to be corrected, scavengers need proper training that caters for improved skill and knowledge on the health and safety hazards they are exposed to and how they can protect themselves at such an environment. The research advocates for more training on waste handling since awareness is a key capacity measure. This is because training is essential in empowering workers to conduct proper use of personal protective clothing in order to minimise injuries and illnesses. The research also advocates that the Bulawayo City Council formulate a policy that governs scavenging and waste picking practices, formulate and facilitate enforcement of set standard operating procedures, train waste pickers on the standard operating procedures as well as provide a mechanism for occupational illnesses and injuries together with other such issues faced by the waste pickers. This will assist them in improving their status quo and improve efforts aimed at attaining SDG 3 on good health and well-being.

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Author contributions A.C.S, K.C.R.M. and T.M. wrote the main manuscript text. A.C.S. and K.C.R.M prepared all figures and tables. All authors reviewed the manuscript.

Data availability No datasets were generated or analysed during the current study.

Declarations

Ethics approval Consent to participate in the research was given by all respondents and interviewees.

Consent for publication Consent for publication of findings was given by all participants in the research.

Competing interests The authors declare no competing interests.

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